Synthesis and characteristics of gold nanoparticles/Epoxy polymer Nano composite material

IOP Conf. Series: Journal of Physics: Conf. Series **1279** (2019) 012005 doi:10.1088/1742-6596/1279/1/012005

Synthesis and characteristics of gold nanoparticles/ Epoxy polymer Nano composite material

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Abstract. Gold nanoparticles were prepared by Turkevich method. These nanoparticles were capped with type of Epoxy polymer. Gold nanoparticles were characterized using UV-visible absorption spectrophotometer to determine the location and the intensity of the SPR absorption package of the uncapped gold Nano composite and those capped with the drugs. It was found that the SPR of the uncapped nanoparticle with Epoxy polymer was at (526 nm), while when capped with the Epoxy polymer was at (670 nm). Characterizing of the shape and size of pure Gold nanoparticles and that capped with Epoxy polymer were done using transmission electron microscopy (TEM).It was found that the uncapped Nano composite spherical shape and diameter range between (5-15)nm and these nanoparticles form the micrographs of transmission electron microscopy) showed that Nanocomposit Epoxy polymer has a fluffy aggregation and the form of Nano composite Epoxy polymer as a flakes or Nano-sheets and Particles Size diameter range between (10-20)nm. Gold nanoparticles were characterized using Atomic force microscopy (AFM), For the purpose of determining the gold nanoparticles structure, X-ray diffraction was used

1. Introduction

Nano materials are revolutionizing our world due to their applications in the areas of medicine, energy, environment and communications among others. Due to the unique properties of these materials that arise at Nano scale, advanced technologies as well as improvements in the existing technologies have been made possible[1,2]. Nano composites are a class of Nano materials with a wide range of properties. These materials are composed of different functional components with at least one component having nanometre dimensions [3,4]. Polymer Nano composites are a subclass of Nano composites that are obtained by combining fillers (nanoparticles, Nano rods, nameplates) with a polymer matrix [5]. Such materials have been explored for numerous technological applications in the areas of photonics, catalysis, electronics, energy storage and biotechnology [6,7]. Particularly, polymer Nano composites containing.

Inorganic fillers like metallic particles dispersed in polymer matrix are of great interest for optical and dielectric applications. Caser et al. [8] utilized gold nanoparticles in order to introduce optical properties such as reversible photochromic behaviour, dichroic etc. to the polymer base materials. They also demonstrated that optical properties (e.g., transparency or colour) could change upon formation of particle agglomerates. The metal Gold has been used by the artists for its amazing optical property of interacting with the electromagnetic visible light

and its good resistance against the corrosion [8] [9]. The free electrons of gold nanoparticles have an ability to interact with the electromagnetic waves which is electrical in nature and implemented in the treatment of diseases, especially in cancer ablation [10]. They have different properties from their bulk solid when the size and the shape dimensions are decreased to the Nano-scale, beside their electronic as well as their optical properties can be obtained in different techniques or methods and used accordingly [11]. The change in their colours are related to the change in their size and shape [12]. Therefore, it makes physicians, engineers, and scientists to work at molecular and the cellular levels for major advances in the life sciences and health care [12]. Polymer Epoxy is composed of two materials. The first is called (hardener) and the second is (epoxy resin). This polymer is a (100%) reactive, whether acids, bases or solvents. It constitutes an insulating layer when dry, which helps interlock chains of polymeric among them when mixing two materials. These two materials mix in a ratio dependent on type of epoxy. In this research the ratio (1:1) was used as equal quantities from hardener and epoxy resin [13].

2. Materials and methods:

2.1 Synthesizing the Gold Nanoparticles

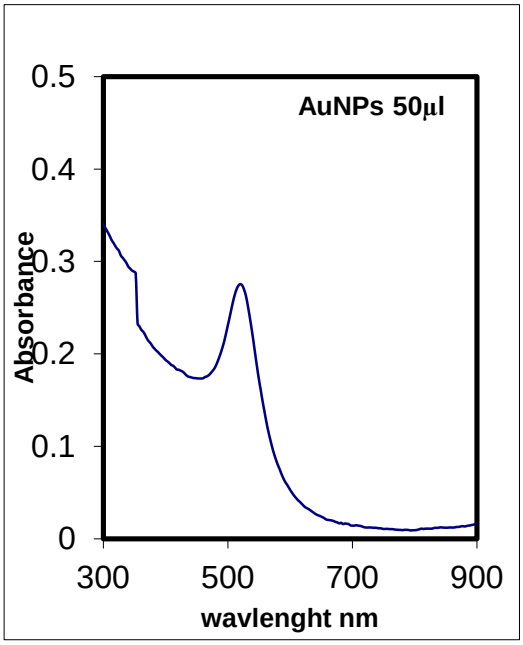
The synthesizing of the gold nanoparticles as recorded by observation for molarity 0.177mM of Chloroauric acid stock solution is used with 500µl from Trisodium Citrate Dihydrate stock solution of molarity 34mM. Actually, this is related to the formation of gold nanowires as an intermediate step during the gold nanoparticles growth. These nanowires tend to absorb most of the visible light, giving the changing in color of the solution to the dark violet color, then they transform into spherical gold nanoparticles which only absorb light in the blue-green region, giving a red-wine color to the solution (only red light is transmitted efficiently).

2.2 Results and Discussion:

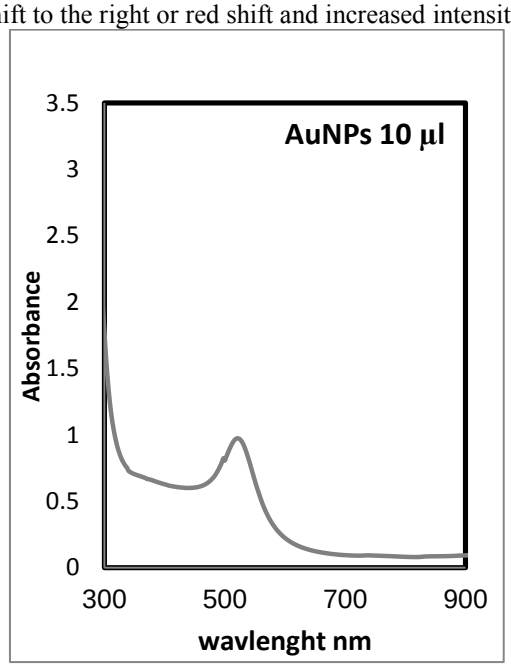
2.2.1 UV-visible Spectroscopy for Absorbance of Surface Plasmon Resonance of Gold Nanoparticles

The volumes withdrawal from AuNPs stock solution (10,50)µl of molarity (0.354, 0.443µM, respectively and The volume of Trisodium citrate dihydrate stock solution is 500µl of molarity 35mM.

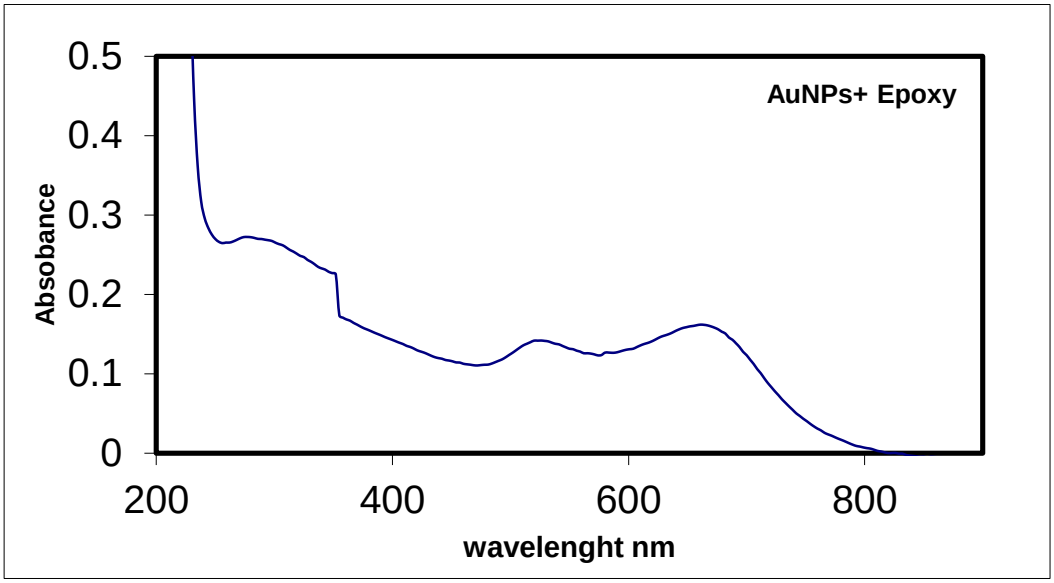
The volumes withdrawn from AuNPs stock solution (10,50) µl from the curves of figure .1 when the volume ratio is increased the surface Plasmon resonance shift to the right or red shift and increased intensity occurred.



(a)



(b)



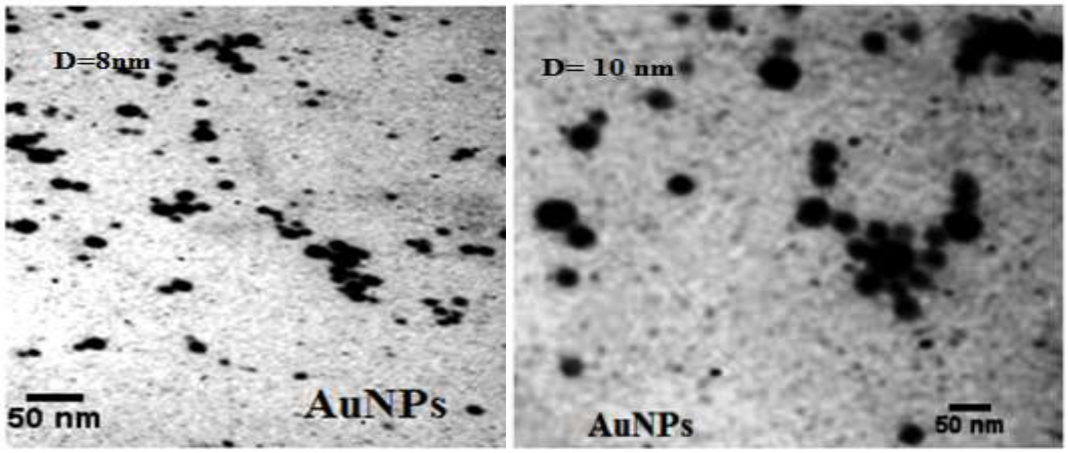
(c)

Figure 1. a-The SPR absorbance AuNPs 50µl b- The SPR absorbance AuNPs 10 µl c- The SPR absorbance AuNPs with epoxy polymer.

2.2.2 Shape and size of of gold nanoparticles of prepared by Turkevich method (TEM).

Figure.2 (a,b,c.d) Show a transmission electron microscopy, which used to take an image to the gold nanoparticles without or with coating by nano with epoxy polymer used for measuring the size of gold nanoparticles. The gold nanoparticles without and with a coating of nanoparticles. The TEM device shows a monodisperse and spherical shape, agree with (Zhao Jingyue et al. 2015) [14]. It was found that the uncapped Nanopcomosite spherical shape and diameter range between (8-10)nm and these nanoparticales form the micrographs of transmission electron microscopy) showed that Nanopcomosit Epoxy polymer has a fluffy aggregation and the form of Nanopcomosite Epoxy polymer as a flakes or nano-sheets and Particles Size diameter range between (15-20)nm.

a. **b.**



c. **d.**

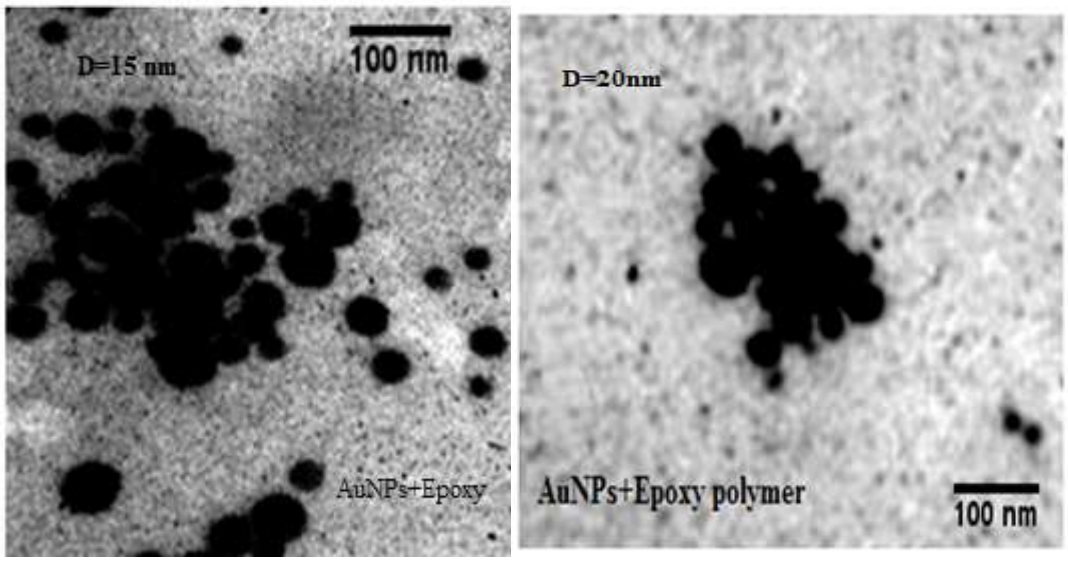


Figure 2. a- TEM image of gold nanoparticales at concentration of 10 µl , b- TEM image of gold nanoparticles at concentration of 50 µl, c- as shown TEM image of gold nanoparticales at concentration of 10 µl coating with Epoxy polymer, d- TEM image of gold nanoparticales at concentration of 50 µl coating with Epoxy polymer.

2.2.3 FTIR Measurement:

The AuNPs synthesized were subjected to FTIR analysis to identify the biomolecules involved in stabilizing the nanoparticles in solution. The AuNPs synthesized by mushroom ex-tract yielded strong bands at 3413.37 and 2066.89 cm−1 in Fig.4 . The band at (3500-3400) cm-1 is for bond of O-H stretching , the bands at 3,413 cm−1correspond to carbonyl and hydroxyl functional groups in alcohols and phenol derivatives and the band at (2000-2500) cm-1 is for bond of C≡C stretching and C≡N. It is well known that proteins can bind to AuNPs through either free amine groups or cytokine residues in the proteins [15-17].

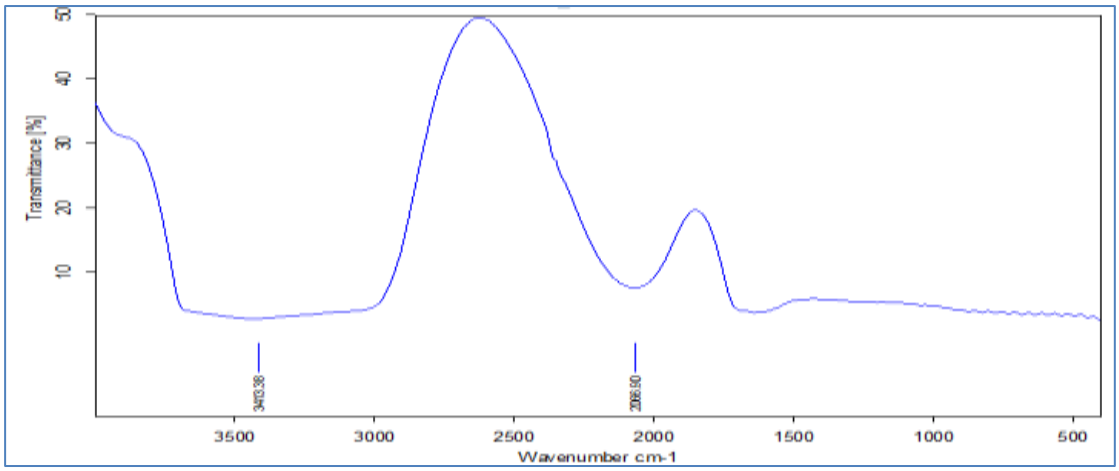


Figure 3. FTIR Measurement of nanoparticles at concentration of 50 µl.

2.2.4 Atomic Force Microscope (AFM)

The morphology and roughness of the thin films were examined by atomic force microscopy in order to provide a large surface inspection of the micro-structural arrays, the observation of the surface morphology of the Gold Nanoparticles as shown in figures 5 a & b.

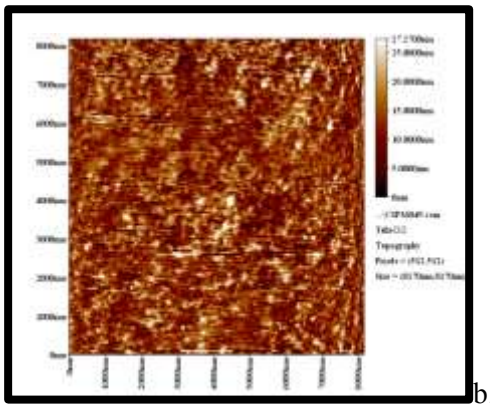
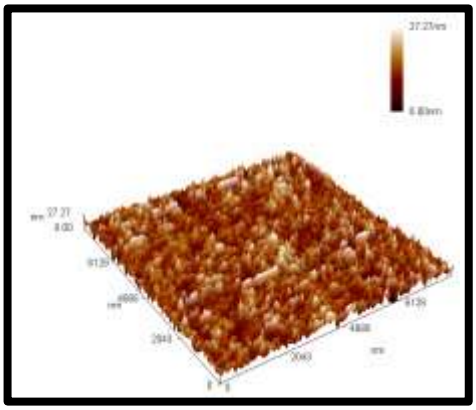
a.  b. 

Figure 4. AFM images of gold nanoparticles concentrations 50 µl a- two dimensions
b- three dimensions

2.2.5 X-ray diffraction pattern of gold nanoparticles prepared Turkevich method.

X-ray diffraction pattern (Figure 5) shows the diffraction peaks of the observed around 37.8227°, 43.7014°, 63.8103°, and 77.1540° which can be assigned to diffraction from (111), (200), (202), and (311) planes respectively. The crystallite size was calculated by the Scherer formula. It is obvious that the crystal structure of AuNPs was the face centre cubic (FCC). All peaks appear abroad, indicating the creation of NPs, the major peak with the highest of crystalline. The results compared with standard values for the card no. (96-901-3039).

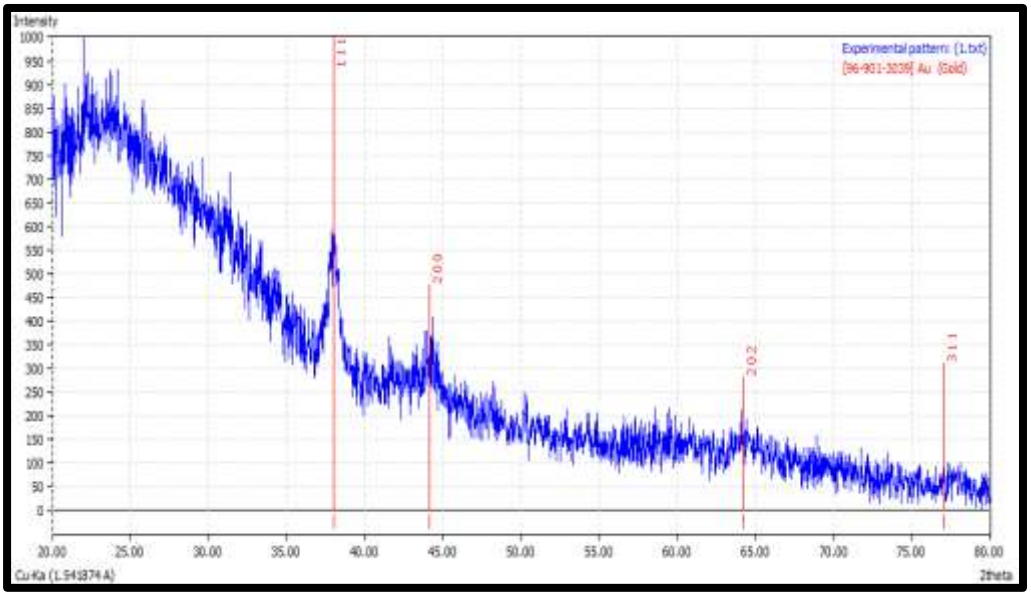


Figure 5. X-ray diffraction patterns of AuNPs prepared by Turkevich method.

3. Conclusion

In present work, we manufactured gold nanoparticles then added epoxy polymer and some materials to modify properties. We absorbed increasing the surface area of the Nano scale size and obtaining characteristics different from the pure compounds. Through exam, the SPR for nanogold increased, when adding epoxy resin polymer to it, and we found the grate transmission of nanogold at wavelength equal 3.8×10-4 cm.

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